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ABSTRACT

This paper presents a report of research on the evaluation of systemic reform of education in science, mathematics, engineering, and technology (SMET), focusing on the Statewide Systemic Initiatives (SSIs) that have been funded by the National Science Foundation (NSF) since 1991. The main purpose of the study was to develop recommendations for the future evaluations of SSIs. Additional goals were: to determine the most important elements of systemic initiatives that must be captured in the process of evaluation, to indicate why these elements are important, and to suggest ways or means of capturing them. The methodology involved interviews with evaluators of systems initiatives, principal investigators, and officials at NSF. There were 19 participants. The principal findings are that: (1) the NSF should be commended for supporting the systemic reform of SMET; (2) either the field of evaluation will encompass the evaluation of systemic reform as a subset or an entirely new field will emerge; (3) the need to evaluate massive SSIs has led to serious management issues at NSF; (4) systemic reform of education has yet to develop a clear and consistent language for alignment of values, policies, and practices while accommodating and coordinating local, state, and federal interests; and (5) the future evaluation of the statewide systemic reform of SMET must show that measurable achievement gains have been realized by the intended audience, especially historically disadvantaged students. The paper includes recommendations based on the analysis of data. An appendix presents interview questions for the study. (Author/SLD)

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Lessons Learned in the Evaluation of Statewide Systemic Initiatives

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Abstract

This article presents a report of research on the evaluation of systemic reform of education in science, mathematics, engineering, and technology (SMET), in particular, Statewide Systemic Initiatives (SSIs) that have been funded by the National Science Foundation since 1991. The main purpose of the study was to develop recommendations for the future evaluation of SSIs. Additional goals were: to determine the most important elements of systemic initiatives that must be captured in the process of evaluation, to indicate why these elements are important, and to suggest ways or means of capturing them. The methodology involved interviews with evaluators of systemic initiatives, principal investigators, and officials at NSF. There were nineteen participants.

The principal findings are: that NSF should be commended for supporting the systemic reform of SMET; that either the field of evaluation will encompass the evaluation of systemic reform as a subset or an entirely new field will emerge; that the need to evaluate the massive SSIs has led to serious management issues at NSF; that systemic reform of education has yet to develop a clear and consistent language for alignment of values, policies, and practices and at the same time to accommodate and coordinate local, state, and federal interests; and that the future evaluation of the statewide systemic reform of SMET must show measurable achievement gains have been realized by the intended audience, especially historically disadvantaged students. The article includes recommendations based upon the analysis of data and closing remarks.

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Lessons Learned in the Evaluation of Statewide Systemic Initiatives

by

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Introduction

. The main purpose of this study is to develop recommendations for the future evaluation of statewide systemic initiatives to reform education in science, mathematics, engineering, and technology (SMET). Since 1991 these have been funded by the National Science Foundation (NSF). The National Institute for Science Education (NISE), located at the University of Wisconsin-Madison, sponsored this research project through a fellowship to the researcher. Dr. Norman Webb, a senior scientist at NISE, served as the systemic evaluation team leader. Additional goals of the study are: to determine the most important elements of systemic initiatives that must be captured in the process of evaluation; to indicate why these elements are important; and to suggest ways or means of capturing them.

Methodology

The overall intent of this study is to report the perceptions of practitioners and officials who are familiar with the current process of evaluating systemic initiatives. The collection of data, chiefly through telephone interviews with evaluators of systemic initiatives for most of the states that have received SSI awards, principal investigators, and officials at NSF, was the research method used. To do this, the researcher developed eight questions that focused on various aspects of the evaluation of systemic reform (see appendix). The data collection process took place during November and December 1996.[1] The interview protocol involved obtaining an individual's willingness to participate in the study, sending a copy of the questions to the participant in advance of the interview, scheduling a convenient time, and conducting the interview. The initial time allotment for telephone interviews was thirty minutes. However, most interviews lasted for ninety minutes or,

[1]Also, on several occasions between January 1996 and June 1997, the researcher traveled to Madison, Wisconsin to conduct literature searches at the University of Wisconsin's Memorial Library and to participate in lively discussion forums with other NISE Fellows, members of the Strategies for Evaluating Systemic Reform team, officials from NSF, and colleagues who work in the field of evaluation.

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in several cases, for two or more hours. The participants prepared their answers in advance of the interview. During the interview, participants provided their prepared responses and also volunteered additional information. In one instance, an evaluation team organized a conference call, so that the researcher could obtain data through a small-group discussion.

All the participants expressed a strong desire to help provide guidance for the future evaluation of systemic initiatives. Some participants said that the interview process was cathartic. It not only gave them an opportunity to describe and explain what happened in a particular state, but it also relieved them of self-doubts about their involvement in systemic evaluations. The latter effect was especially important to evaluators of states that were "defunded" by NSF.

There were nineteen participants. Initially, the researcher recorded and transcribed the data in accordance with the questions of the interview protocol. Later, he analyzed the data for themes and supporting details. To a large extent, the results of this study are made up of the statements provided by the participants—with many of them expressing strong agreement on most issues.[2]

Systemic Reform

"Never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity." —George Smith Patton, 1885-1945

What does systemic mean? The word systemic literally refers to that which is related to, or common to, a system or complex of systems,[3] such as the human body. The body's systems may be whole or discrete parts, such as the nervous system or brain, blood circulation or heart, and so on. In this adjectival form, systemic denotes the flow or at least the passageway of something vital; hence, the importance of the nervous system simultaneously to human thought processes and physical movement. Conditions may exist in the organism that are either healthy or unhealthy. Also, external elements may be fed into one or more systems which promote a particular response that can affect one or more systems. For example, a systemic pesticide is a toxic substance that kills insects by interfering with their normal metabolic processes—systemically—and, thus, assures greater crop

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[2]The paucity of information provided by the study participants on the second question under "Evaluation of Systemic Initiatives (see Appendix, p. 55) is due to the ambiguity and complexity of the question itself, participants said. Also, according to participants, the central issue regarding the evaluation of these systemic initiatives has been the manner and extent to which NSF has exercised its influence on the process.

[3]Systems theory, the foundation for systemic reform, was first proposed in the 1940's by the biologist Ludwig von Bertalanffy and was developed further by cyberneticist Ross Ashby. There have since been many new developments and applications of systems theory. For a study of the early work, see Ludwig von Bertalanffy, *General System Theory: Foundations, Development, Applications* (New York: G. Braziller, 1968); and William Ross Ashby, *Introduction to Cybernetics* (New York: J. Wiley, 1956). For recent applications, see these two works by George J. Klir *Facets of Systems Science* (New York: Plenum, 1991) and *Architecture of Systems Problem Solving* (New York: Plenum, 1985).

productivity or a lower incidence of pest-borne disease. Systemic antibiotic therapy is a form of treatment in oral surgery.

Both positive and negative images are instructive. Because an organism (including all manner of social organisms) functions with systems, problems can be identified, understood, treated, and solved via those systems. By the same token, the growth or development of a huge social system, such as statewide education, can be enhanced by maximal use of its various systems. Thus, total systemic educational reform seeks to improve the education of children by introducing improvements throughout the parts of the system, such as changes in state legislation and policy, teachers' professional knowledge and skill, content area standards, and standards-based assessment. Systemic reform implies the continuous renewal to adapt the educational system—that is basically good—to new and unforseen circumstances and, in the process, strive for significantly improved educational results.

In these times, talk about reform of American society is common, especially in reference to government and education. However, this is not new. "What should be the relationship between the federal and state governments?" was the heart of debate on the U.S. Constitution, as preserved in the Federalist and Antifederalist speeches, articles, and letters from 1787 to 1788, prior to ratification.[4] The debate unfolds today in appeals for "systemic" reform of government, from politicians who sit on both sides of the "aisle" in Congress and from a host of critical, outspoken citizens. No one knows where the debate will lead nor, for that matter, if it will ever have a conclusion. Indeed, in the American constitutional government, this ongoing debate is a fundamental political process to assure the republic that its elected rulers will foment neither tyranny nor anarchy. Over time, emphasis on this political debate waxes and wanes. Today there is a broadly-based yearning for a better American government. Systemic reform is the by-partisan effort to lead the way.

There are also vocal critics who call for systemic reform of public education in America. In this instance, systemic reform refers to changing the systems of publicly supported education. Through the years, there have been many large scale efforts to change public education in America.[5] In the decade of the 1960s, Americans implemented new curricula in response to the criticism that Russia was winning the space contest with Sputnik. At best, the results of the changes were mixed. Publication of *A Nation at Risk* in 1983 propelled the "first wave" of criticism of American teachers for their generally low level of content knowledge, for their lack of adequate pedagogical skills, and for the low standards accepted for students' learning. Results of educational assessment indicated that U.S. students fared poorly in math and science, especially, in comparison with their peers in some Asian and European countries. Later in the 1980s, a "second wave" of school reform saw educators and public policy officials embrace organization theory in an attempt to explain what's wrong with American public schools. Subsequently there was a focus on restructuring the

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[4]Consult the two volume set by Bernard Bailyn,. ed., *Debate on the Constitution* (New York: Literary Classics, 1993).

[5]Maris Vinovskis, "An Analysis of the Concept and Uses of Systemic Educational Reform," *American Educational Research Journal*, Vol. 33, No. 1, Spring 1966, pp. 53-85.

organization and management of schools, which led to recommendations for, and implementation of, decentralization and site-based management.

Systemic reform is the "third wave" in contemporary educational reform. President George Bush launched the bi-partisan initiative as Goals 2000 at the historic Charlottesville Education Summit of 1989. William Bennett was his Secretary of Education. Currently, President Bill Clinton continues this commitment as a centerpiece of his administration, with Richard Riley as the Secretary of Education. The chief architects of Secretary Riley's policy toward systemic educational reform, Marshall Smith and Jennifer O'Day, emphasize the federal government's leadership role in systemic educational reform.[6] Its crest bares the following terms: expanded role of states in public education; standards-driven and intellectually challenging curriculum and assessment; and provision of truly equitable opportunities for all children to learn—especially in math and science. At the present time, the Department of Education is soliciting states' voluntary participation in a national achievement testing program.

Critics of Secretary Riley's policy initiative claim that systemic school reform does not give sufficient emphasis to basic knowledge and skills or to parents' role in the school's decision-making process and to the choice of school that their children would attend. Some of the critics claim that there is no scientific basis for "systemic reform;" there is only a strong belief, or rationale, that "changing" the system of education in accordance with these normative principles will lead to significant increases in students' math and science achievements, especially among poor and historically disadvantaged children. Its protagonists, who were sure-footed prior to the dramatic change in the U.S. Congress in fall 1994, now express chagrin that "the standards movement seems far more fragile than the future of enhanced local control."[7] Some supporters have issued the call for a balancing of the old and the new across the curriculum.[8] Phonics programs that once were condemned to the proverbial dust bin are now recognized for their particular purpose in helping children learn to read. The politics of educational reform had gone so far that President Clinton said

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[6]Carl Kaestle and Marshall Smith, "The Federal Role in Elementary and Secondary Education, 1940–1980," *Harvard Educational Review*, 52, No. 4, 1982, pp. 384-408; Jennifer O'Day and Marshall Smith, "Systemic Reform and Educational Opportunity," *Designing Coherent Education Policy*, Susan H. Fuhrman, ed. San Francisco: Jossey-Bass, 1993; and Marshall Smith and Jennifer O'Day, "Teaching Policy and Research on Teaching." (Paper prepared for meeting of Working Party on the Condition of Teaching, OECD, Paris, France, 1988); For an interesting critique of systemic reform and a fresh set of policy recommendations, see William Clune, "The Best Path to Systemic Educational Policy: Standard/Centralized or Differentiated/Decentralized?" *Educational Evaluation and Policy Analysis*, Vol. 15, No. 3, Fall 1993, pp. 233-254.

[7]Amy Wells and Jeanie Oaks, "Potential Pitfalls of Systemic Reform: Early Lessons from Research on Detracking," in *Sociology of Education*, special issue, 1996, pp. 135.

[8]Margaret Goertz, Robert Floden, and Jennifer O'Day, "The Bumpy Road to Education Reform," a paper submitted to the second annual NISE forum, February 1997.

recently that it must now stop at the schoolhouse door. Proponents also openly admit that "there is no theory of systemic reform; there is only an idea that advocates have been working on for several years and some innovative practices that are undertaken in its name."[9] Systemic reform may be entering a sober, more mature phase.

The National Science Foundation has expressed its interest, with hundreds of millions of dollars per year, in systemic reform of SMET through several initiatives, namely, Statewide Systemic Initiatives (SSI), Urban Systemic Initiatives (USI), Rural Systemic Initiatives (RSI), and Local Systemic Initiatives (LSI). As stated earlier, the particular interest of this research is the lessons learned in the evaluation of SSI. To date, NSF has furnished three rounds of funding that provided five-year SSI grants of up to $2 million per year to twenty-four states and the Commonwealth of Puerto Rico.[10] Connecticut, Massachusetts, Louisiana, Vermont, and Puerto Rico have received renewal funds for an additional five years. An abiding interest of all SSIs is the improvement of teaching and learning of SMET in ways that are consistent with new and developing standards for curriculum and professional development.

Ten Elements for Effective Systemic Evaluation

What has been learned about the evaluation of statewide systemic initiatives? To answer this question, the researcher organized the data from the responses into ten categories of elements or issues and related lessons. The categories emerged from strong patterns in the data. No effort was made to establish what exact number or percentage of participants gave a particular response, because there were no questions of the forced-choice type. Only the pre-established, structured interview questions were used, and participants were encouraged to speak openly in response to each question. Hence, the responses were both voluntary and individual. Nonetheless, most of the items are supported (i.e., they were specifically identified) by a significant majority of the interviewees, so there is substantial agreement among the participants. Some items came from one or two individuals, but the reputations of these practitioners and the integrity of the items (based on their relevance to the preponderance of data) made them suitable to include in the lists of categories and lessons. Recommendations for improvement follow the discussion of each element.

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[9]Quote from a plenary speech by an official of NSF at the second annual NISE forum, Washington, DC, February 1997.

[10]Daryl Chubin and Susan Gross, "Evaluation of the SSI Program: An NSF Staff Interpretation," A program evaluation report in response to third-party evaluation and monitoring findings delivered under contract to NSF, February 1996.

Ten Elements for Effective Systemic Evaluation

- **Clarify the idea of systemic reform and its relationship to systemic evaluation.**
- **Recognize that the social and political conditions of a state impinge on the systemic initiative and its evaluation.**
- **Capture the most important elements of systemic initiatives.**
- **Resolve the differences over the use of program evaluation and systemic initiatives evaluation.**
- **Assure that evaluators of statewide systemic initiatives have appropriate qualifications.**
- **Remedy what does not work well or remains elusive in the evaluation of systemic initiatives.**
- **Adopt minimum standards for writing reports of systemic reform.**
- **Allocate sufficient time and money for the evaluation of systemic initiatives.**
- **Improve the development and implementation of policy for systemic evaluation.**
- **Coordinate evaluators and evaluation designs.**

- **Clarify the idea of systemic reform and its relationship to systemic evaluation.**

Lessons from the Field

The participants agreed that NSF should be commended for recognizing the importance of improving science and mathematics education by providing support for the reform of state education systems. They said that the previous reform initiatives at the federal level, while important in and of themselves, were not sufficient. If the nation is to make substantive gains against its own record—especially with historically disadvantaged and minority groups— and against the records of other nations in the teaching and learning of SMET, the "third wave" of school reform, with its focus on entire statewide systems of education, is a necessary direction to take.

Participants noted that the idea of systemic reform is relatively new. It is bound up with the idea and process of systemic evaluation, and both aspects are emerging (i.e., the ideas have come a long way since the first proposals were reviewed in 1991). Furthermore, they noted that neither aspect is particularly well understood by anyone—not among officials at NSF, not among the evaluators or theoreticians at universities, and not among the practitioners, such as executive directors of the SSIs. In the words of one participant, "It's like this: we are flying the plane while we are still in the design stage. But that's life."

Participants called for everyone associated with systemic reform to adopt an open-minded and inventive perspective on systemic evaluation. They said, "We have never tackled the whole system before." Key participants at all levels have come to know systemic reform and systemic evaluation

as *new and gradually emerging ideas* of educational reform and improvement.[11] For instance, participants described the original conceptions of systemic reform as well-intentioned, but idealistic and naive on the part of all parties. In fact, a number of participants had served on review teams for NSF when the agency was selecting SSI proposals for awards and, thus, are well aware of the original thinking and conditions for decision making.

Most participants said that, especially in recent years, they have grown increasingly disappointed with NSF's conception of systemic reform and, in particular, systemic evaluation. Participants felt that NSF's policies for implementation and evaluation of SSIs have become too narrow. They also said that over the past five or six years NSF's language about both systemic reform and systemic evaluation has changed frequently and remains ambiguous.[12] In other words, despite the fact that several years have passed during which great strides have been taken by different states toward implementing systemic reform of SMET, the language that NSF uses to talk about the initiative it helped to spawn has become less and less clear. Therefore, the concepts and related processes or operations are even more difficult to discuss in a tangible manner. The participants indicated that the source of this problem with language lies in the federal organizational structure and the mind-set of NSF itself.

In their discussions of NSF's language about systemic reform and systemic evaluation, the participants say that federal policy development and financial support for systemic reform of science and mathematics education should be established through genuine collaborations with key players in the program development and evaluation of various state initiatives. First, they say that these matters should be handled in an open, collaborative manner, because collaborative decision-making among all of the key players is consistent with the underlying principles of systemic reform. Authoritative, top-down decision-making is an organizational model that systemic reform is to replace at all levels of education. Second, they say that everyone who is associated with SSIs needs to understand that the ownership of statewide systemic reform and systemic evaluation of SMET is a local and state matter. NSF and other federal agencies may contribute suggestions to the states' development of better systems of education—and that is entirely consistent with the national interest in educational improvement—but in the final analysis, these SSIs are "state-made and state-owned."[13]

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[11]Compare with Michael Fullan and Matthew Miles, "Getting Reform Right: What Works and What Doesn't," *Phi Delta Kappan*, June 1992, pp.745-752.

[12]The issue of ambiguous and abstract language in systemic reform is raised persuasively by Michael Fullan, "Turning Systemic Thinking on Its Head," *Phi Delta Kappan*, February 1996, pp. 420-423.

[13]Diane Ravitch wrote about the federal interest in prescriptive education (telling not simply what, but also how to do something) in *The Troubled Crusade* (New York: Basic Books, 1983), p. 308.

- **Recognize that the social and political conditions of a state impinge on the systemic initiative and its evaluation.**

Lessons from the Field

There are several very good reasons why a standardized or federal approach to statewide systemic reform and evaluation of education cannot work. The most obvious reason is that provision of free, public education to all of a state's youth, *in loco parentis*, is the constitutional responsibility of the individual states.[14] The movement for public schooling in America began when the Massachusetts Bay Colony passed its compulsory literacy law, known as *The Old Deluder Satan Law*, in 1647. Since then, all states have adopted their own legislation that would provide free and public education to all children who live in the state. Home schooling, parochial schools and private or independent schools are legitimate, viable alternatives to state-sponsored education. However, at certain intervals, the federal government has exercised its authority to provide leadership on behalf of all American citizens and thereby impacted on states' public education with, for example, the landmark Civil Rights Act of 1964, the Elementary and Secondary Education Act in 1965, and the Americans with Disabilities Act of 1990. Nonetheless, every state exercises discretionary action in regard to the laws, policies, and practices it may deem prudent for the public education of its citizens.

How else *could* an astute observer comprehend what is going on? Beyond the constitutional foundation, there are some other compelling reasons for always viewing systemic evaluation from the standpoint of the particular state.

All the participants called attention to the perennial mischief of state politics, especially with regard to the fortunes of an initiative of such great scope and requiring so much time and collective energy for development—and from so many key people in state politics—as a statewide systemic initiative in SMET. A key operating principle for every successful SSI is that it must continuously interact with *all* the key players in the state's political arena, regardless of their stance *vis à vis* the SSI. However, the sand is constantly shifting.

As mentioned previously, the election of a governor (the state's equivalent to the nation's president) would occur at least once during every SSI's five-year time frame. Also, depending on the outcome of that election, the governor may change key personnel in the various state departments, such as the commissioner of education, who are of greatest concern to the initiative. In addition, state representatives and senators with varying influence, perspectives, and bills on public education will move in and out of the political arena. The appointments of state supreme court justices, their judicial decisions, particularly in regard to educational matters, and the state legislature's enactment of new laws and public policy all can develop in ways that are impossible for the initiative to anticipate. (It cannot control them.) Sometimes the results are favorable. At other times the consequences for the SSI are costly, or even disastrous, at least for the present term.

Two other important matters are the state's recent history of economic development and the size and allocations of its annual budgets. A healthy economic picture would not necessarily lead to more

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[14]For a thought-provoking argument in favor of home schooling, see Seldon Richman's *Separating School and State* (Fairfax, VA: Future of Freedom Foundation, 1995).

support for the policies, programs, appointments, and practices that would benefit the SSI. Conversely, a bad state economy would not necessarily mean that the SSI would not flourish. Indeed, the participants said that there is no handy formula or magic bullet to apply because, if it existed, they would have employed it long ago. There is only the systemic evaluation team's preparedness to act in a timely, intelligent, collaborative, and positive manner on every significant development in the state. They also said that the overall quality of the evaluation team's response in the quirky realm of politics—at all levels—has an important impact on the systemic initiative's ongoing development.

The social and political issues are also bitterly antagonistic at the school district level. According to one participant, "The superintendent *has* to be on line for systemic reform and evaluation." However, the turnover of school superintendents of large cities is frequent, often occurring every two or three years, and may be highly charged emotionally. The process of selecting a replacement may take six months or longer. Regardless of the interval, it always leads to delays in the district's operations. In order to attempt to bring about better results than the predecessor, the incoming superintendent usually changes the school reform and improvement agenda for the district. Also, the results of school board elections and the board's future decisions will have an impact on the quality of education realized by the children in the district. A main point brought out by the participants was that these variable social and political conditions of the local school district must be accommodated in a sophisticated, diplomatic manner by the systemic evaluation. Why? No one has *carte blanche* approval to collect documentation on the initiative's impact. Cooperation with all school districts must be solicited and cultivated over time in a careful, sincere manner by the evaluation study team.

The teachers unions are another concern in systemic reform. Indeed, they are the largest, most powerful, and wealthiest organized labor force in the country. Among other things, systemic evaluation should assess the impact of the statewide systemic initiative on the teachers' development of knowledge and skill with teaching science, mathematics, and technology. However, how can systemic evaluation secure the cooperation of the teachers' unions for the assessment of teachers' professional competencies? Should systemic evaluation assess the teachers' competency in terms of the impact of their instruction on students' learning as measured by a test—as logic and science would suggest? Participants characterized that suggestion as either taboo or nonsense, depending on their perspectives.[15] Indeed, some participants strongly opposed the tactic on the grounds that there is apparently no research-based linkage between the two and there is no test adequate for the task. Using surveys to assess teachers' attitudes about changes in the educational process has been relatively easy to do, participants said, but the results have been fruitless—in some cases bordering on fraudulent. Other participants declared that the object is to know if the teachers' methods have

[15]Compare with David Cohen's discussion of SSI issues, including teachers' academic knowledge and skills, pre-service preparation, and so forth in "What Is the System in Systemic Reform," *Educational Researcher*, Vol. 24, No. 9, December 1995, pp 11-17, 31; also, see Susan Loucks-Horsley, "The Role of Teaching and Learning in Systemic Reform: A focus on Professional Development," a paper presented at the second annual NISE forum, February 1997.

changed as a result of the initiative and to what extent these changes contribute to improvements in students' learning, especially in science and mathematics. They argued that there is a need for systematic use of good, quantitative instruments of measurement. Systemic evaluation must obtain that data on students and teachers, but how?[16]

When there is turnover of key project personnel in the offices of the SSIs, there could be problems with the SSI's development and evaluation. Some problems that participants cited are false starts, loss of momentum, a need for regrouping and re-visioning, hiring of new personnel, and retraining. All of these take substantial time and energy from the goals of the initiative and the accomplishments of remaining personnel. Participants reported that, in some instances, NSF was insensitive to, and impatient with, turnover problems. However, this finding suggested an interesting contradiction. The high rate of turnover of NSF's own program officers created considerable problems for the SSIs, e.g., operations had to be put on hold for the site visits from NSF's new team. However, NSF's officials were impatient or unsatisfied with the problems created by turnover at the SSI, and thus, the project was at risk of being "defunded."

Finally, participants noted that officials at NSF often assert that they must give reports to Congress—an accounting of the results of the SSI's multimillion-dollar. Political activity at the federal level, particularly as it impacts on and subsequently emanates from NSF, may adversely influence the development and the evaluation of systemic initiatives. Participants report that NSF's officials often harangue SSI officials for their failure to produce documentation that is needed to convince Congress of the positive results from its spending. Why does NSF pass this negative political influence on to the SSIs?

According to participants, NSF should recognize that everyone must give an accounting to someone. Executive officers of the SSI's have constituencies in their states, such as a Board of Directors and invested partners from business and industry, who regularly ask for and expect an accounting of the progress and results from the SSI. It would be better policy, participants asserted, for NSF to see the SSI officials—including systemic evaluators—as friendly collaborators who must face their own "Congress," even though it is within a different political arena. NSF's fostering of cooperation instead of opposition could make the difference between its delivery one day before the U.S. Congress of the ordinary shtick and the powerfully convincing evidence. For clarification, there was no talk of holding back efforts or information. There was only an intimation of the grand difference in human affairs that springs from mutual respect. In the interest of succeeding with systemic reform, NSF should take advantage of that sentiment.

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[16]See also Linda Darling-Hammond, "National Standards and Assessments: Will They Improve Education?" *American Journal of Education* 102, August 1994, pp. 478-510.

- **Capture the most important elements of systemic initiatives.**

Lessons from the Field

Many participants asked, "What is the main target of systemic reform?" The following answer from one participant's conveys the majority's perspective:

> "Systemic evaluators need to know what the target should look like five years ahead; then they can know what evidence to collect. Will the main target be teachers, students, or schools? This decision must be made in advance, and then steps can be taken to assess or measure the manner and extent of the project's impact on the target(s). Also, perhaps the 'gauge' of national level systemic reform is not the same as the 'gauges' of systemic reform at the state levels."

Another question that participants asked regarding the important elements of systemic initiatives is this: "What are the indicators of successful systemic reform?" The most frequent answer is, "Whoever decides the answer to this question, must explain the process that led to the identification, description, and explanation of these indicators."

Baseline data concerns the statistical description of the population prior to the impact of the treatment on that population (or a representative sample). An accurate record of such data would be valuable for assessing or measuring the impact of SSIs, especially on students and teachers. NSF has indicated that it wants each SSI to provide baseline data. However, participants indicated that this baseline data is either missing, incomplete, or disputable.

Many initiatives did not have statewide assessment policies and procedures in place until sometime after their initiatives began. Some do not have them in place now. Indeed, the development and implementation of statewide, standards-based assessment of students' achievement in science and mathematics—along with the relevant curriculum and instruction—was one important reason for their application to NSF for the SSI grant. Hence, if there were no statewide tests, there was most likely no statewide baseline data.

In states where testing was conducted statewide prior to the award for the SSI, the tests in all probability were not standards-based, since the National Council of Teachers of Mathematics (NCTM) standards were adopted as recently as 1989. The *National Science Education Standards* were still in the development stage when the first cohort states received SSI awards, and the science standards were not officially adopted until 1996.[17]

Also, some states that had statewide testing programs in place prior to receiving their SSI awards went through a number of iterations of those tests to create the contents and format for their tests that would accurately reflect their policy, practice, and the new standards. Hence, the students' "condition" relative to the newly implemented standards-based curriculum and instruction were not entirely valid, even when statewide test data was available, because the data and instruments were moving targets for one another. Furthermore, the actual schedules for policy development and

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[17]National Council of Teachers of Mathematics (NCTM),*Curriculum and Evaluation Standards for School Mathematics*, (Reston, VA, 1989); National Research Council (NRC), *National Science Standards*. (Washington, DC: National Academy Press, 1996).

implementation of the systemic initiative's key provisions, including adoption of standards-based curriculum frameworks and statewide assessment of students' achievement in science and mathematics, varied within and between the states. In other words, there was nothing like a controlled condition common to experiments where concerns for baseline data might apply.

In addition, subsequent to the first cohort's awards, NSF changed its focus for all SSIs. This required some states to add substantial elements to their projects that they had not included in their original proposals, such as adding a focus on science when their original proposal focused only on mathematics. Thus, even if the state had obtained baseline data on the elements of its original proposal, it most likely would not have obtained such data on NSF's later requirements.

Baseline data is an important benchmark from which to assess progress. However, the concern for getting valid baseline data on the SSIs raises a number of questions. What will be designated as the baseline data? Who will make this determination? How will the data be secured after the passage of five or six years? What are the implications for SSIs, for NSF, and for systemic evaluators when the question of what is the baseline data is determined *post hoc*?

Participants expressed little hope that true baseline data could be obtained for the SSIs. They indicated that systemic evaluation should concentrate on documenting as clearly and accurately as possible the *process* of an SSI as it unfolds in the state over time. It should also document certain *effects or correlates*, like students' achievement and teachers' professional knowledge and skills, that the evaluation team could assess (or measure), describe, and explain. Thus, there was strong participant agreement that, when this data was systematically collected over time, several aspects of systemic evaluation would reveal the impact of the SSIs. They expect that this positive result would be revealed and these data could be substantiated, whether or not there is any so-called baseline data.

Participants included the following items in their list of important data for assessing the impact of SSIs. The systemic evaluators' methods for data collection would comprise qualitative and quantitative approaches in order to document:

- teachers' classroom practice, in general, and their use of methods and materials for instruction in science and mathematics, in particular;
- teachers' professional development programs in terms of the impact on teachers' knowledge and skills, perceptions, and the type and quality of programs;
- case studies of schools and districts to capture the processes and products of systemic initiatives within and across the states' different social and cultural contexts;
- the systemic initiative's impact on students with standardized tests through representative sampling, not universal testing;
- knowledge and skills of the project's executive director, including familiarity with systemic evaluation, the state, and the initiative's "political wax," that is, how well it functions in the various, changing, and highly competitive social arenas.

Participants stated that a significant emphasis of systemic evaluation must be on capturing, analyzing, and reporting the process as well as important effects or correlates. This is necessary so that the key people at different levels have a well-informed position on what is happening with the SSI relative to its goals and objectives and so that they can make the right decisions to guide the

initiative. Data that has no relevance for decision-making by key personnel is useless. Collecting it is a waste of everyone's time and money.

- **Resolve the differences over the use of program evaluation for evaluation of systemic initiatives.**

Lessons from the Field

Participants are divided on the answer to the question, "Is program evaluation different from systemic evaluation?" Some participants point out that the methods and approaches used currently to study the systemic reform of SMET are merely a logical extension and continuing development of the techniques and perspectives that were developed over the past thirty years in the field known as program evaluation.[18] Other participants point out that systemic reform calls for a new idea about evaluation, which they call systemic evaluation. Although the methods and tools or instruments might be the same in both endeavors, the latter requires a "different approach." Also, advocates of systemic evaluation would say that the difference is one of type, not merely of degree.

Participants associated program evaluation with the following characteristics:

- study is directed by the goal of the program or project;
- activities and events are identified beforehand and show a logical relationship to the program's goals;
- the evaluator's role is to serve as an external (more or less external) "critical friend;"
- results are attributed to a single or small number of pre-established sources;
- the path from process to product is relatively clearly delineated;
- a theoretical framework guides thought and practice;
- results of the evaluation appear on formative and summative bases.

Advocates of systemic evaluation pointed out that it differs from program evaluation on criteria that are apparently unique to systemic reform. Those participants included the following elements:

- goals of systemic reform are negotiable and will vary over time;
- activities and events associated with systemic reform must be flexible and adapted to the specific and emerging circumstances;
- the evaluator's role as "critical friend" of the initiative may be internal, external, or both;
- a myriad of sources influence the development of a systemic initiative;
- the theory of systemic reform has not been articulated to date;
- the evaluator's delivery of results in "formative-like"reports is common and necessary for development of the systemic initiative;
- and summative reports are intermediate, never final.

The descriptive characteristics for program evaluation and systemic evaluation suggest that a continuum rather than a dichotomy explains the relationship between these two approaches to evaluation. Indeed, one of the participants explained the difference as one of degree, rather than kind, and provided the researcher with a diagram to illustrate the point (Figure 1).

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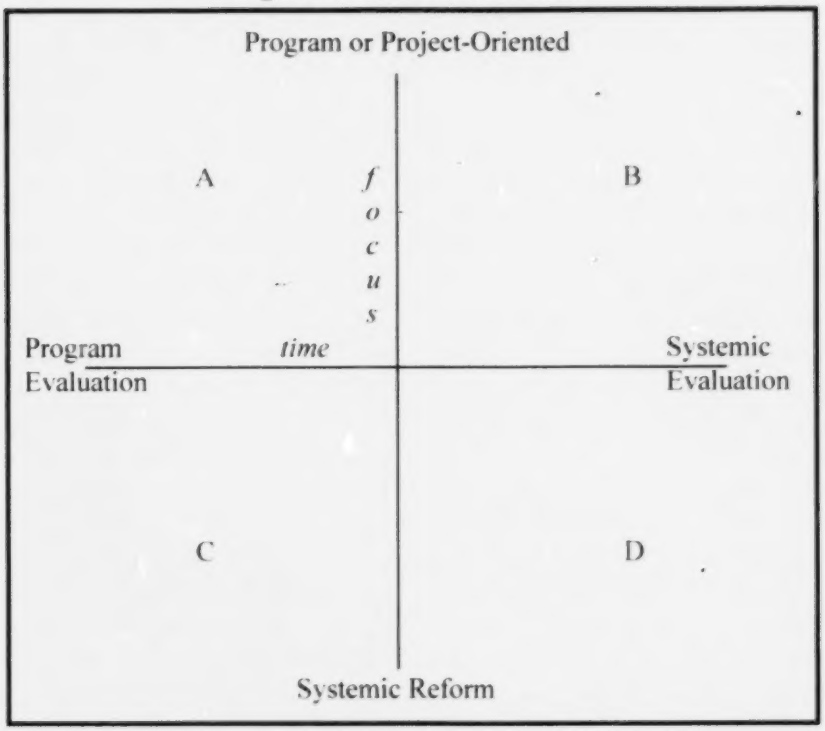
[18]See Michael Scriven, *Hard-Won lessons in program evaluation*. San Francisco: Jossey-Bass, 1993.

Figure 1: Field of Evaluation



An evaluator could work in either of the four quadrants and near to, or far from, a horizontal or vertical line. A shift in the focus from a specific program (also known as project) to systemic reform indicates that there will be a significant increase in human resources (including a team of researchers who have content specialties), time, and money due to the attendant complexity of SSIs. The following are three additional points of significance in reference to this characterization of the field of evaluation: (1) the same methods (qualitative and quantitative) and techniques (tests, surveys, observation, interview, etc.) are available to the evaluator, regardless of the focus for the evaluation (vertical axis), although the particular configuration of field study methods depends on the circumstances in the field and the evaluator's preferences; (2) the focus (vertical axis) for the evaluation shifts attention from a single entity in quadrants A and B to multiple aspects in quadrants C and D, thereby accommodating the shifting and complex spheres of activity common to systemic reform; and (3) the virtues of program evaluation are not necessarily lost on systemic reform. Concerning the latter, an evaluator who is conducting a systemic evaluation may want to focus on a particular aspect of the systemic initiative in order to study the phenomenon in isolation—at least temporarily—and proceed with little or no influence from the multitude of convoluted and changing issues that are typical of a systemic initiative.

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All participants thought of the systemic reform evaluation as linked intimately to the idea and development of statewide systemic initiatives or, at least, to a particular systemic initiative. Also, since there is as yet no theory of systemic reform and, since program evaluation is intended for multi-dimensional approaches and methods and adaptable to different and multiple foci, this perception of the field of evaluation (Figure 1) seems to encompass participants' different viewpoints and is true to the field-based practice. Nonetheless, because systemic reform is about improving huge, politically complex and changing, statewide systems of SMET education, and, because program evaluation did not specifically anticipate such an avenue when it originated approximately thirty years ago, new ideas or frameworks and processes will have to be designed for the evaluation of systemic reform. This phenomenon could indicate that the field of evaluation is simply passing through an important developmental stage—a common occurrence in any field—and things may very well continue in this fashion. Otherwise, proponents of systemic evaluation must make the case that a bifurcation is clearly evident[19].

On the one hand, some of the participants in this study emphasized the distinctive importance to systemic evaluation of documenting the *process* of systemic reform through qualitative research methods. The purists in this group would argue that there is no need to be concerned with quantitative measures. However, to the extent that quantitative approaches are used, they would at least distract attention from what is important, if not in the long run actually do harm to the initiative on state and national levels. Also, they expressed strong disagreement with what they see as the current orientation of NSF and some evaluators, which they believe favors quantitative assessment, especially the use of standardized tests to measure the impact of a systemic initiative on the improvement of students' math and science achievement.

Instead, these participants said that the nature of systemic reform—namely, that it concerns the complex and ongoing "process" of *systemically* reforming a statewide educational system—calls for the use of methods that are uniquely suited to the documentation, analysis, and ongoing development of social and political processes. That would be qualitative research methods, such as observation, interview, attitude and interest surveys; collection of documents and artifacts; and focus groups. Participation is also a technique that they would say is useful for systemic evaluation, but it would not be passive or done merely to get a "feel" for what it's like to be a part of the initiative. Instead, participation would include positive actions (e.g., taking key management positions within the initiative and conducting workshops for guiding the professional development of teachers) that are taken by the evaluator to bring about particular results for the SSI.

On the other hand, a majority of participants took a pragmatic stance and emphasized striking a balance between concerns for documenting the process of systemic reform through qualitative research methods, such as those mentioned above, and assessing its products. Those products include measuring students' gains or losses in achievement tests in mathematics and science as correlates

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[19]For a discussion of a theory of systemic evaluation see Daniel Heck and Norman Webb, "Purposes and Issues of Systemic Evaluation in Education," a paper prepared for the National Institute for Science Education, September 1996.

to the policy, curriculum, and instruction that were introduced by the systemic initiative. In the opinion of these participants, no one today can dodge the public demand for accountability, especially in spheres of government and education. Indeed, they cite the bipartisan Government Performance and Results Act of 1993, which goes into full implementation in 1999, as consequential, in that it requires all recipients of federal support be held accountable to measurable results, unless there is a convincing argument that a program's objectives and activities have no measurable results.[20]

However, there is an aspect of "documentation," done in the name of systemic evaluation, about which virtually all of the participants were in agreement. They said there should be nothing done purposely and ostensibly to "document" systemic change which may be recognized by evaluation experts as "senseless bean counting." Indeed, most of the participants characterized NSF's 1995-96 data collection effort as a mammoth, last minute effort at bean counting.[21] The participants reported that there was nothing in the exercise, or for that matter in the findings, that was beneficial to the SSIs. Furthermore, they would say that it was in the first place a poor decision to standardize the data collection process across those states that are all so different from one another. They said that there may be a time in the near future when a study group made up of evaluation experts will identify—on the basis of sustained research—the reasonable, common characteristics that are shared by the different states, but they were convinced that at this time no one knows what those characteristics are.

- **Assure that evaluators of statewide systemic initiatives have appropriate qualifications.**

Lessons from the Field

To reiterate briefly, participants note that the idea and the practice of systemic reform and the process of systemic evaluation are new, complex, and emerging entities. They are also intimately related to each other. These systemic initiatives are not yet well-defined—in their theoretical and practical realms—by anyone. Thus, to acknowledge that the development of a statewide systemic initiative is an immense undertaking that encompasses vast uncertainty is to say that the evaluation of that enterprise must be an intelligent, assessment-oriented study of the particular focus and long term development of each statewide systemic initiative. All of this calls for devoted commitment and intelligent planning and action on the parts of everyone concerned at each level.

The participants emphasized several points in regard to the qualifications they believed anyone involved in systemic evaluations should possess. First, the evaluator must be highly skilled and, also,

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[20]Daryl Chubin, formerly of NSF and currently serving in the Department of Education, discussed the implications of the GPRA of 1993 to NSF's ongoing mission in "Systemic Evaluation and Evidence of Education Reform," in Dennis Bartels and Judith Opert Sandler, eds., *Implementing Science Education Reform: Are We Making an Impact?* (Washington, DC: American Association for the Advancement of Science, 1995). See also Daryl Chubin and Susan Gross, "Evaluation of the SSI Program," an NSF evaluation report, February 1996.

[21]This sentiment was expressed publically by a plenary speaker at the second annual NISE forum, February 1997.

broadly experienced in methods of evaluation. One of the participants stated the following:

> "We need to redefine the role of evaluators. In fact, they play multiple roles that go beyond merely collecting and analyzing data. They are advocates and collaborators. They educate people on systemic reform. They know that systemic evaluation is not just active; it has to be responsive, that is, flexible to the changing circumstances of the SSI."

As already mentioned, the participants were divided on the question of whether the emphasis of systemic evaluation should be with the qualitative or quantitative approach. Most of the participants argued for a combination of both methodologies. However, there was no disagreement about the need for the evaluator's high level of expertise, regardless of the approach that would be used to assess the accomplishments of the SSI.

Participants also stressed the importance to systemic evaluation of the evaluator's appreciating and maintaining the distinction between merit and worth. Whatever policies and practices the SSI would implement, they would have to be judged as valued, that is, instrumental, to the systemic initiative's ongoing accomplishment of its goals.[22] What worked in one year might not be appropriate or necessary, at least not in its original form, in the next year. (Indeed, such an orientation would be perfectly consistent with the systemic problem that the SSI was meant to resolve, whether the concern is development or evaluation.) The evaluator must be cognizant of the rapidly changing circumstances and always be prepared to adapt methods and viewpoints that are best suited to the overall goals of the SSI.

Another area of special concern to participants addressed the individual evaluator's strengths and weaknesses in content areas, especially in the different sciences, mathematics, and technology. In fact, every participant noted that not only was the SSI as a whole a complicated process, but so also is its intended impact on areas of education as vast as science, mathematics, engineering, and technology. These are areas of rapidly emerging and intellectually demanding work and no one person can conduct a systemic evaluation single-handedly. They said that the demands of systemic evaluation in the content areas alone, require a team of people. Each team member would possess different strengths in science, mathematics, or technology, so that as a group they would possess the knowledge and skill collectively that would be necessary for assessment of the SSI.

Additionally, the evaluation team must be politically savvy among both private and public sector participants and at various levels of state and federal government, including state departments of education and higher education, K-12 school districts, colleges and universities, and NSF. Carrying out its mission to conduct the systemic evaluation of a statewide systemic initiative demands that the team continually adapt to changing circumstances; that it incorporates a collaborative style in its spheres of decision making and work in regard to both its internal and external operations; and that it has a flexible schedule.

Nonetheless, something inevitably happens, and no one on the evaluation team can predict what or when. Nor can they guess whether the source of greatest influence (or reaction) will flow from

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[22]Scriven, pp. 67-68.

the governor's office, state legislature, state department of education, partners in business and industry, NSF, a special interest group, or the initiative itself. Participants would say that conducting systemic evaluation is like confronting the Hydra of Greek legend. Accordingly, the evaluation teammates must be constantly prepared to identify, as early as possible, the particular changes in circumstances and to help create responses that will facilitate the systemic evaluation. At the same time they must improve upon the SSI's chances of accomplishing its goals. (According to participants, these same strengths that are required of evaluators are also necessary qualities for SSIs, whether one works at the state level or NSF.)

Participants mildly disagreed on the manner and extent of influence or involvement that the systemic evaluation would have on the systemic initiative. Some participants argued that the systemic initiative's success depended upon having a systemic evaluation that was an integral component of the systemic initiative. Under such circumstances, the evaluation team would have a crucial role and explicit functions in the development (from its onset), management, and operations of the initiative. This pro-active model was recognized as successful by most participants. It is a good example of systemic evaluation. Nonetheless, in the opinion of its practitioners, the pro-active model might not work in some states.

Effective evaluators have held either internal or external positions in the systemic initiative. Also, participants expressed agreement on the viability of each option and provided noteworthy examples of each approach. They would say that the pro-active internal evaluation design and the pro-active external evaluation design each in its own way, contributes substantially to the idea, design, and activities of the systemic initiative and lead to a high profile for the service of evaluation in the interest of systemic reform. Furthermore, a majority of the participants said that systemic evaluation needs some combination of both internal and external approaches.

Is the evaluator trustworthy and dependable? Does the evaluator have credibility? These are important questions in any line of work and the participants made it clear that these character traits are no less important to systemic evaluation. Although exercising poor judgment by an evaluator was not cited as a frequent occurrence, the participants did provide some examples of instances when evaluators broke rules of confidentiality or when an evaluator betrayed, or did not give credence to, some of the key participants in an initiative. Usually, these errors in judgment happened on the local level, that is, somewhere within the initiative itself, and the issue was resolved at that level. However, occasionally the error was made by someone who crossed the all-important boundary between the federal (NSF) and state (SSI) levels. When this happened, "all hell could break loose" and the consequences could be very damaging, especially for the systemic initiative. Hence, the simple lesson for systemic evaluation is that evaluators use the best methods to gather truthful statements about the accomplishments of SSIs. They must be careful to address their findings in a timely fashion, to the appropriate audience, and with the best protocol.

The result of the evaluator's work on the systemic evaluation of a particular statewide systemic initiative can have important implications not only for the quality of the evaluation, but also for the direction, pace, and overall success of the systemic reform effort on state and national levels. In several instances, the SSI has retained the same evaluator or evaluation team throughout its development. The best known and most frequently cited are Zoe Barley & Mark Jenness at the

University of Michigan–Kalamazoo, Mark St. John of Inverness, and Iris Weiss of Horizon Research, Inc. During the five or six years of the SSI's development, the executive officers of the SSI may have moved on, the state legislature may have changed course several times, two or three different governors may have been elected (which would entail numerous changes in the appointments of state officials), and, as indicated above, there were changes in program officers at NSF. However, throughout this time the SSI continued its development in accordance with its goals and objectives, and the systemic evaluation team remained intact. There is evidence that the particular SSI has been institutionalized to some extent. Those people who conduct the evaluation will most likely have the most up-to-date and comprehensive institutional memory of the state's systemic initiative as they are the only ones from the original group who are remaining at the helm.

Finally, some individuals may have the credentials on paper, but they may lack the organization, management, or personal relations skills necessary to conduct a systemic evaluation successfully. Often university professors are a case in point. The participants said that the extent to which university professors positively influence the development and the evaluation of systemic initiatives is contingent upon their knowledge, skill, and determination to implement relevant programs. A professor's ordinary routines, which may include conducting controlled experimental studies, writing articles for professional publications, and deliberating in committee meetings, are ill-suited to systemic evaluation. Participants noted that some SSIs recognized too late that their reliance on an unqualified evaluator was costly—there was a low quality of service for the fees that were paid, or that the results put the initiative and its evaluation at risk.

- **Remedy what does not work well or remains elusive in the evaluation of systemic initiatives.**

Lessons from the Field

Participants stated that an important aspect of the evaluator's role is helping the project management team think about the big picture of their SSI and at the same time provide technical assistance with its implementation. The quality of the systemic initiative's "vision" or big picture and its relationship to the project's operations, collaboration, and capacity-building are the key elements that explain the initiative's success. However, these elements are not conceived by traditional means of assessment, namely bean counting, old-fashioned norm-referenced tests, workshop attendance rates, and "feel good" attitude surveys. Survey instruments that are used to measure students' and teachers' perceptions can be useful or useless, depending on their design and administration.

Standardized tests that do not provide for task-oriented or problem-solving items do not adequately assess the impact of standards-based instruction in science and math. Also, a systemic initiative is moving and changing constantly, making it difficult or unwise to rely too heavily on standard measures for assessing its impact. Furthermore, the improvement of a state's mathematics program may differ significantly from the improvement of its science programs.

Nonetheless, participants acknowledged that increases in students' test scores would be the best indicator to convince the general public that SSIs are accomplishing their goals. However, they also noted that good statewide assessment is expensive and, when it is implemented, takes time and may furnish surprises and uncertainties. The tests are not administered one day and the results delivered by overnight express the next. Students' portfolios may be included. Several months may pass. Also, anything can happen at any time to make assessment data difficult to obtain in any form or on a

timely basis from the state department of education. In some cases, the assessment data is not collected or owned by either the state department or the initiative, which may entail negotiations with uncertain outcomes. Additionally, participants said that five years is not enough time to realize substantive gains, particularly in regard to measuring the impact of the systemic initiative on students.

Participants noted that the SSI encompasses a vast network of agencies and people, each of which has its own agenda, and yet works in cooperation and collaboration with the gradually emerging systemic initiative and its evaluation. It is not a smoothly running machine. In fact, the intent and design of the SSI is to replace the myth of the machine—at least in K-12 education in science and mathematics.

- **Adopt minimum standards for writing reports of systemic reform.**

Lessons from the Field

Participants said that the systemic evaluation team needs to know what to look at, what to document, and what to report. Also, participants said that, while they were not advocating a standard process of evaluation, they believe evaluators nonetheless need to know what are the commonalities across all sites, while appropriately capturing the differences that are due to local preferences and culture. The systemic evaluation should capture different levels of the systemic initiative's operations, including specific, internal activities as well as general, statewide issues, but the reporting procedures and documents must be designed and reserved for the appropriate audience.

The concern for audience reminded participants of another important point about the reports. There should be an "airing out" of the findings of the evaluation to appropriate audiences prior to formal dissemination of a report. In other words, before an evaluator simply and cavalierly distributes the report upon completing the writing, another step should be taken. The process of systemic evaluation must include a process of report writing, which involves feedback and discussion of findings prior to final approval of the report.

Also, evaluators should know that their formal or summative reports that are given to the SSI's executive director might not go automatically to the appropriate, highest authority. Hence, the evaluator should prepare reports that are appropriate for different audiences and take responsibility for ensuring there is full dissemination of the findings.

Lastly, participants noted that NSF's officials seem not to have made good use of the evaluators' reports and, especially, the systemic initiative's documentation, which was required by NSF.

- **Allocate sufficient time and money for the evaluation of systemic initiatives.**

Lessons from the Field

Participants said that there are at least the following four functions of the evaluation of systemic initiatives: (1) meet the needs of NSF's requests for accountability, (2) substantiate the systemic initiative's success with the state, (3) conduct research on the lessons learned in the process, and (4) become a critical friend of the management and design team. Completing all of the above successfully requires sufficient time and sufficient money. The participants' best estimate for a reasonable budget for systemic evaluation was 10%–15% of the total annual budget for the systemic initiative.

As a sidebar, participants noted that, because of their positions, NSF's officials and university

advisors have unrealistic conceptions of budgets, especially where time and services for evaluation by independent, private-sector contractors are concerned. For this reason, there may be uneven and low budgets for systemic evaluation and poor estimates of evaluators' fees for extra duties, such as serving on panel discussion groups and other professional exchanges. The quality of the reports on the impact of the various SSIs will, to some extent, be a consequence of their different budgets for systemic evaluation.

- **Improve the development and implementation of policy for systemic evaluation.**

Lessons from the Field

Participants acknowledged that NSF has taken an important step in the direction of improving education in SMET by implementing the statewide systemic initiatives. However, they were nonetheless strongly convinced that NSF's posture on the evaluation of systemic initiatives is ineffectual and, furthermore, is inconsistent with the nature of systemic reform. They described NSF's decisions and communications, in general, as exercises in authority, seemingly for the purpose of establishing its "theory" of systemic reform as the controlling idea for this educational reform movement. From the participants' perception, NSF is preoccupied with determining the terms and conditions of systemic initiatives and also influencing the nature and purpose of systemic evaluation. Thus, participants would say that NSF has fostered the impression—if not the implicit policy—that it will use systemic evaluation to monitor and control systemic reform. "Systemic evaluation can't be defined as enforcement of mandates and 'vision,'" a participant said. Participants unequivocally disapprove of this purpose for systemic evaluation.

The most convincing evidence for this claim about NSF's posture on systemic evaluation came from the participants' descriptions of NSF's site visits. Repeatedly during this study of the lessons learned in the evaluation of systemic reform, the participants described NSF's site visits as fault-finding missions that had unclear and inconsistent information in regard to technical assistance for the site. Those visits, concurrently, included threats to "defund" particular initiatives unless there was compliance with NSF's wishes.

Additionally, the participants explained that NSF's site visitors and program officers changed too often, and too frequently they had only a meager understanding of the culture (i.e. the specific reality of social, political, educational, and economic issues) of the state and region of the country that they were visiting. The site visitors' continual turnover and poor background on the history of the state and its people who were implementing the SSI was most likely even more damaging to the SSIs' development than the forewarning that they would be "defunded" (unless there was some kind of compliance) and the inadequate technical assistance from NSF.

Participants described SSIs as expedient and resilient in the face of enormous historical statewide obstacles to change. The participants also acknowledged that there were some weak and failing SSIs and that these—like all of the other SSIs—should have been held accountable for accomplishing their goals. Nonetheless, the participants would say emphatically that NSF's site visits were notorious for creating an atmosphere of indifference, aloofness, and foreboding wherever they occurred. In some instances, NSF's site visits resulted in the "defunding" of SSIs for what was perceived by participants to be insufficient cause. Usually, there was inadequate prior notice and little clarity regarding the manner and extent to which the SSI did not measure up to NSF's expectations.

According to participants, one of the most egregious and oft-repeated errors of NSF is *its* changing the terms and conditions for SSIs and, then, holding the SSIs accountable for *NSF's* decisions. In the states that were defunded, there is ample bad feeling regarding this *faux pax*.

Participants described many NSF's site visits as ill-timed, given the political conditions of a particular state and its systemic initiative at that particular time. When the timing for a site visit was especially bad for an SSI, the NSF site visitors' insistence on having it occur according to NSF's schedule would cause the initiative's evaluators and project directors to forgo all concerns for the project's developmental needs for the time being in order to meet the terms of the visits and follow-up activity.

None of the participants questioned the validity of having site visits. However, everyone expressed serious reservations about the qualifications of the personnel who were employed as program officers and site visitors, in addition to their high turnover rate. Also, given the high level importance attached to the site visits and the high stakes decision that these visitors would make, the projects' directors and evaluators expected that NSF would at least provide clear statements of its expectations, maintain consistent interests in particular policies and practices for implementing and evaluating statewide systemic reform, and base its decisions on reasonable evidence and inquiry. NSF has a widely acknowledged history of changing the language of systemic evaluation and reform (without gaining clarity). Consequently, its expected shifting of the priorities for development and evaluation of systemic initiatives only served to blur the focus and distract key personnel from implementing the main elements of their statewide systemic initiatives.

In the opinion of participants, NSF did not exhibit clarity and consistency in its policies regarding systemic evaluation. Even in circumstances where NSF's site visitors proclaimed the initiative to be accomplishing its goals in an acceptable and timely manner, the actual site visit created unnecessarily high levels of frustration for the project director and evaluators. In instances when word came back from Washington that the site visit team had decided to "defund" a statewide systemic initiative, there was dismay and disillusionment among the key SSI personnel. These individuals had put their reputations and careers on the line. Now, suddenly they would be terminated. The participants said that NSF's policy and operations in regard to program officers, site visitors, and the site visits themselves were the most poorly conceived and badly managed aspects of systemic evaluation.

- **Coordinate evaluators and evaluation designs.**

Lessons from the Field

Participants report that the following individuals and corporate groups have been cited often by their peers as having had a positive influence on the evaluation of systemic initiatives: Iris Weis of Horizon Research, Zoe Barley and Mark Jenness of Michigan State University at Kalamazoo, Joy Frechtling of Westat, Mark St. John of Inverness, Thomas Corcoran at the Consortium for Policy Research in Education, and Andy Zucher and Patrick Shields of SRI International.

Also, participants report that their most important influence on the evaluation of systemic initiatives is the evaluators' own professional experience. A secondary source is other evaluators (see above). A tertiary source of influence has been the key players in the systemic initiative. Unfortunately, the participants view NSF's influence as negligible or obstructive.

The following is a summary of participants' gleanings from systemic evaluation:

"These are some things that evaluators know about systemic evaluation:

- We need to be flexible with the particular projects and patient with the process of their development as a whole.
- We need to be clear about what we say we are trying to do in systemic reform.
- We need to make a conceptual framework or a design for systemic reform and evaluation, including a hierarchy of values, so that everybody knows what we are doing and how to assign priorities. The process of evaluation should include both internal and external components.
- We need to have a vocabulary of specific, clearly understood terms and use it consistently.
- We will gain stability in both systemic reform and systemic evaluation through clarity and consistency. One method is to retain the same site visit teams from year to year.
- There needs to be adequate money budgeted for systemic evaluation.
- Useless bean counting is not what we need."

Participants said that a leadership council is needed for the development of concepts, policy, and practice in the systemic evaluation of SSIs. Also, they said the evaluation of systemic initiatives should include a genuine receptivity to accepting different, "local" configurations of statewide systemic reform of education in science, math, and technology and to accepting different kinds of evidence and inquiry. There should not be an impression that all systemic initiatives and systemic evaluations must conform to one way. Thus far, NISE has been instrumental in filling the void in guidance and leadership for the evaluation of systemic initiatives.

Recommendations

1. Gain clarity on the idea of systemic reform and its relationship to systemic evaluation.

- An advisory council of experts from relevant areas of expertise is needed. They would identify, define, and maintain, over the long term, the fundamental principles, values, and terms associated with the statewide systemic reform of education in mathematics, science, and technology.
- The advisory council should, primarily, insist that the language used in all essential documents concerning SSIs is clear, reasonable, and precisely understood by all parties.
- The advisory council should serve as an advocate and provide support for the local organizations of statewide and regional forums to disseminate and critique SSIs. This would include in-depth discussion of evaluation methods, instruments, software, and results.

2. Recognize that the social and political conditions of a state impinge on the systemic initiative and its evaluation.

- Systemic evaluation must be given autonomy and time to design and implement assessment strategies that work (i.e., are useful) at the local level and the state level in order to become the lifeblood of an SSI. This is necessary because social and political conditions of states undergo such dynamic changes within the states and because these effects vary so greatly from state to state.

- Both long term (5, 10, and 15 years) and short term (1 and 3 years) plans are needed in each statewide initiative in order to have success with its systemic reform of mathematics, science, and technology education. Individual states should design their own plans and each should include appropriate policies for systemic evaluation on both the state and federal levels. The evaluation should stress accountability; reporting and analyzing the state's changing social, economic, and political conditions; and supporting the timely modification of plans.
- Evidence of nonfeasance or malfeasance should be recognized as just causes for "defunding" or discontinuation of a statewide systemic initiative. A one-year period of probation and supervision would occur when objectives are not met in a timely manner and when operations, activities, and materials are not consistent with the standards for systemic reform. The systemic initiative should be given clear guidelines for improvement, made aware of the consequences, and monitored and counseled in a collaborative, positive manner. A broadly-based peer review team that includes local officials, executive directors from other statewide systemic initiatives, content area specialists, evaluators, and NSF officials would oversee this.

3. Capture the most important elements of systemic initiatives.

- NSF should establish clear and specific policies regarding the timing for the collection and the content of baseline data that is relevant to each statewide initiative. This should be done regardless of the historical development of the initiative. Common baseline data should be identified and specified along with the timing and means for its collection. NSF should collaborate with state officials for establishing these policies.
- NSF should establish a realistic, clear, and long-term time line (based on 5, 10, and 15 year plans) for accomplishing national goals. These goals should encompass the systemic reform of mathematics, science, and technology education. This should be done in collaboration with the individual states and on a state-by-state basis.
- The approaches, methods, and instruments for systemic reform evaluation should be eclectic, accountable, and well-suited to the specific locations and the varied purposes for assessing the development, operation, impact, and mission of statewide systemic initiatives.

4. Resolve the differences over the use of program evaluation for evaluation of systemic initiatives.

- There should be an advisory council of expert practitioners and theoreticians of systemic evaluation, as recommended by the participants. Their duty would be to define the policy, content, and methodology for the evaluation of statewide systemic initiatives.
- This advisory council should publish, in a timely fashion, an authoritative monograph on the theory (or competing theories), lessons learned, and best practices for systemic evaluation of systemic reform of education in SMET.

5. Assure that evaluators of statewide systemic initiatives have appropriate qualifications.

- A vital component of each statewide systemic initiative's management unit should be an appropriate emphasis on internal systemic evaluation of the project's operations and its impact. Its purposes would be to assess—from the standpoint of the "allied friendly critic"—the SSI's main activities and to provide feedback on a regular basis. This feedback

would provide information on the quality of specific operations and the manner and extent to which the intermediate and annual objectives are being accomplished. The team members who conduct this evaluation should have experience with systemic evaluation; should be very familiar with the state, the project, and the chief players; and should have expertise in curriculum and professional development for the improvement of the state's science, mathematics, and technology education. The team would report directly and routinely to the project's key personnel.

- The internal evaluation team, in some states, may take responsibility for designing and implementing activities that are key to the project's success. An example would be workshops for the professional development of school teachers and administrators.
- Each statewide systemic initiative should have an external systemic evaluation that provides balance and is not redundant to the SSI's emphasis on internal evaluation. Its purpose would be to assess—from the standpoint of a "detached friendly critic"—the project's overall development in regard to its vision, goals, and objectives as they relate to systemic reform on annual, three-year, and five-year intervals. The external evaluation should emphasize collection and analysis of data that is relevant to the common interests for measuring the impact of systemic reform in that particular state. This evaluation should be conducted by a team whose members collectively have broadly-based expertise in conducting systemic evaluation of science, mathematics, and technology education. This team would report to key personnel of the state initiative and to NSF.
- The internal and external evaluation teams may be complementary elements of a single systemic evaluation enterprise.

6. Remedy what does not work well or remains elusive in the evaluation of systemic initiatives.

- Design data collection forms and instruments specifically for describing and measuring the development, progress, and impact of systemic initiatives on the state's target populations. This population includes teachers, students, parents, school officials, business and industry representatives, other key participants, the state legislature, and public policy makers.
- Establish research and development sites at various levels and locations to conduct well-coordinated, non-obtrusive, in-depth studies as related to systemic reform of mathematics, science, and technology education. These studies would be on the history and the effects of the new directions in curriculum materials, methods of instruction, policy, and professional development.
- Promote the work of SSIs and systemic evaluation teams who design, institute, and coordinate the statewide policy. This policy would be for professional development of teachers and school administrators, technical assistance providers, school boards, and technology education from Kindergarten through graduate school, including professional schools for teachers and administrators.

7. Adopt minimum standards for writing reports of systemic reform.

- Establish general guidelines for evaluators to follow when writing and disseminating reports to local, state, and federal officials. These guidelines would be helpful when reporting on the development and measurement of the impact of a statewide systemic initiative.

- Provide feedback on the content, usefulness, and overall quality of the report of the project. This should be reported to the evaluators and the appropriate state's officials as soon as possible.
- Emphasize report writing in particular—and systemic evaluation, in general—that is valued by and is, at least, practically and immediately useful to all parties. At the same time, the reports and evaluation should contribute to theoretical work associated with the systemic evaluation and the reform of mathematics, science, and technology education.

8. Allocate sufficient time and money for the evaluation of systemic initiatives.

- Internal and external evaluations should be required for all statewide systemic initiatives. The costs should be divided appropriately between NSF and the initiative's collaborating partners in the state.
- Costs for systemic evaluators should be competitive and market-driven. Internal evaluators should be locally-based. Evaluation procedures and products should meet the highest standards.
- Establish deadlines and timing for evaluators, reviews, and reports or assessments of the development or impact of systemic initiatives. This should be done through a collaborative, cooperative agreement between the particular state's officials who are responsible for the systemic initiative and NSF's officials.

9. Improve the development and implementation of policy for systemic evaluation.

- NSF should establish policy to assure that its site visitors and program officers are the best candidates for long-term assessment of the strengths and weaknesses of specific statewide systemic initiatives. This policy would include criteria for hiring, protocol for site visits, and multiple site-based personnel evaluations.
- NSF should establish the minimum criteria, forms, and processes for evaluating the impact of systemic reform across all states in an effort to address common interests.
- NSF should establish policies that govern each particular state's specific criteria, forms, and processes for evaluation.
- NSF should appoint a panel of systemic evaluation experts whose duty it is to review and officially approve all proposals for the evaluation of SSIs. This would provide assurance that the highest standards will be applied in the renewal or extension, evaluation, and/or "defunding" of all SSIs.

10. Coordinate evaluators and evaluation designs.

- Establish a national leadership council for the development of concepts, policy, and practice in the evaluation of statewide systemic initiatives to reform mathematics, science, and technology education.
- Organize a network of evaluators with interest and expertise in systemic evaluation. Solicit their participation in collaborative ventures (both private business and publically supported institutions) in the long-term evaluation of statewide systemic initiatives.

Closing Remarks

The main purpose of this research project is to discuss the lessons learned regarding the evaluation of systemic reform. Specifically, the researcher was directed to develop recommendations for evaluating statewide systemic initiatives that concern the reform of science, mathematics, engineering, and technology education. In addition, the researcher would delineate the most important elements of systemic initiatives that must be captured in the process of evaluation, indicate why these elements are important, and suggest ways or means of accomplishing them. The methodology consisted of structured interviews with a wide variety of people who are familiar with SSIs. In these closing remarks, the researcher presents a synthesis of the lessons learned. Specific details and recommendations appear in the preceding sections.

The findings appear in a series of ten lessons from the field and accompanying recommendations. These particular lessons and recommendations are analytical constructs or categories that the researcher devised from the interview data. The overall purpose of the lessons is to describe the way practitioners conduct the evaluation of systemic reform in the context of an issue and participants' perceptions of what it means to do their work. Participants were not hesitant to indicate what they perceived to be important discrepancies between the way they felt the practitioners' work should be done and the manner and extent to which it usually is done. In other words, the researcher did not have difficulty identifying principal issues and problems associated with the evaluation of systemic reform, because the participants presented clear discrepancies.

One finding is that the area of work known as evaluation of systemic educational reform is poised either for field-based theory alignment or construction. If further studies suggest that theory alignment is the direction to take, then the concept of program evaluation will encompass a sub-specialty known as the evaluation of systemic reform. However, if follow-up research indicates that there is a significant difference between program evaluation and the approaches and methods that are necessary for the evaluation of systemic reform, then a new construct will emerge—systemic evaluation. This research exposed the controversy, but did not resolve it. Taking that next step in either direction would contribute significantly to the development of a theoretical construct for the evaluation of systemic reform.

Also, the data indicates that the problem of how to evaluate systemic reform has created serious management issues at different levels, especially at NSF. This result is not surprising. In recent history, no governmental agency—neither state nor federal—has ever attempted to reform and improve the content and process of education on such a grand scale and with such important and dignified goals as those which were adopted by NSF for statewide systemic reform of SMET. The officials at NSF should be applauded for this grand beginning. Nonetheless, in every new and magnificent enterprise, mistakes are made, and they were made.

The data indicates that the management style and design for the evaluation of systemic reform must be brought into full alignment with the values, policies, and practices which are characteristic of systemic reform. These lessons learned about the federal role in evaluating statewide systemic reform should not be lost on the states and local communities. In these times, there is a general expectation on the part of the citizenry that the status quo in government affairs at all levels—local,

state, and federal—must yield to the significant changes in policy and practice that are necessary for success in the information age. The message for evaluation of systemic reform is to increase the levels and aspects of collaboration with key partners, to foster cooperative working relationships, to be consistent, and to be flexible.

Another issue concerns clarity in use of language. Participants stated that there is no theory of systemic reform and there is no theory of systemic evaluation. Furthermore, the language used when discussing systemic reform and evaluation is both ambiguous and inconsistent. Why can't educators be more articulate, so that others—including other educators—clearly understand their messages? An important lesson learned about the evaluation of systemic reform is that everyone involved must develop the appropriate vocabulary and use it consistently.

Who should benefit from the SSIs? And who is going to be held accountable for the results, whatever they are? Systemic evaluation should reveal that systemic reform contributes to students' experiencing improved teaching and learning in science and mathematics. This is especially beneficial for students who come from poor and historically under-served minority groups. What will be the criteria designating the quality of the expected impact on these students? How will the actual result be determined or measured?

This is the era immediately after the U. S. Congress passed the GPRA. "The Congress finds that waste and inefficiency in Federal programs undermine the confidence of the American people in the Government and reduces the Federal Government's ability to address adequately vital public needs."[23] Hence, federally funded programs must now demonstrate the accomplishment of measurable objectives in outcome measures. Who will be accountable for the results of the SSIs? Will teachers be held accountable for improving their content area knowledge and methods of teaching? What instruments and measures would be appropriate as "output measures?" How rigorously would the assessment and documentation process be applied to schoolteachers? Participants said that senseless bean counting should be out. Many SSI states have "output measures" for the students in the form of mastery tests. Should teachers be held accountable in the same manner? What about school administrators and staff? What kind of rationale would justify a significantly different measurement device for adults? This lesson about the evaluation of systemic reform concerns fairness, honesty, and rigor. SSIs must be held accountable for measurable results, but who will assume this responsibility? How? And what will be the implications for systemic evaluation?

Finally, participants noted that the political climate for systemic reform and evaluation has undergone substantial change since the heady days of the first cohort's awards. Forty-eight percent of the states' governors are now Republicans. In fall 1994, the U. S. Congress dramatically shifted control of the House and Senate to Republicans. Subsequently, the emphases—if not persuasions—of many people in education have changed from a conspicuous disregard for so-called traditional educational values to a benign acceptance of all things that work in the name of balance and fairness.

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[23]Government Performance and Results Act of 1993, One Hundred and Third Congress of the United States of America.

This change in thinking about educational programming is consistent with the bipartisan spirit endorsed by President Clinton and the 105th Congress. The lesson learned here is that ideology and partisan politics have no place in the education of children and, therefore, have no place in systemic reform and evaluation.

Appendix

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The Evaluation of Systemic Initiatives

Interview Questions for Evaluators, Principal Investigators, and NSF Officials

Main Purpose of the Interview

To develop recommendations for the future evaluation of systemic initiatives.

Overall Concern

- What are the most important elements of systemic initiatives that must be captured in the process of evaluation? Why are these elements important? How do you capture them?

Evaluation of Systemic Initiatives

- What or who has had the greatest impact on your evaluation of a systemic initiative?
- What have you done to address the following issues related to collection of data on systemic initiatives?
    - Size of the system
    - Number of components
    - Uneven development
    - Limited view of participants
    - Multiple groups and levels within groups; e.g., state department of education, state and local government, higher education, business and industry, parents, neighborhood organizations, teachers unions and professional organizations, etc.
    - Other issues (please specify)
- What aspects of the evaluation of systemic initiatives work very well? Why?
- What aspects of the evaluation of a systemic initiative do not work well or remain elusive? Why?
- How should evaluators gather and report evidence to show that there is a relationship between improvement in students' mathematics and science achievement (including teachers' classroom practices) and a systemic initiative?
- What is the most important and persuasive evidence of a systemic initiative's value, in general, *and* for the improvement of teaching and learning science and mathematics, in particular?
- What procedures should be in place to assure that evaluators collect valid information?

Recommendations

- What recommendations do you have for the evaluation of systemic initiatives? Why?

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